Water Resource Room HOVE

DRINKING WATER SOURCE PROTECTION PLAN

Hovenweep National Monument

December 2000

Prepared by:
Larry Martin
National Park Service
Water Resources Division
1201 Oakridge Drive, Suite 250
Ft. Collins, CO 80525
(970)-225-3515

WATER RESOURCES DIVISION

National Park Service - Department of the Interior
Fort Collins - Denver - Washington

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UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF DRINKING WATER

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July 3, 2001

Joe Joliet
National Park Service
HC 60 Box 1
Lake Powell, Utah 84533

Dear Mr. Joliet:

Subject: Drinking Water Source Protection Plan for Hovenweep National Monument
1437 Ft. Well, System No. 19014, Source No. 01

Thank you for submitting the Drinking Water Source Protection (DWSP) Plan for the Hovenweep National Monument 1437 Ft. Well. We have reviewed the DWSP Plan for the well, but **we cannot concur with this plan until the items explained below are addressed**, and the information resubmitted for review. References are to the *Standard Report Format for Existing Wells and Springs. Please note that transient non-community systems are not required to have approved DWSP plans, so you may submit the requested information at your discretion.*

3.0 Inventory of Potential Contamination Sources

Septic systems cannot normally be considered "adequately controlled", since they are designed to discharge. However, your routine maintenance involving pumping out the system suffices as an adequate management plan for this potential contamination source (PCS). No change is necessary, other than noting in your plan that septic systems are uncontrolled PCSs.

6.0 Management Program for Future Potential Contamination Sources

The minimum requirement for this section includes:

- Contact each PCS as it moves into your protection area
- Determine whether it is actually a PCS
- if it is, add it to your inventory
- Identify and assess it's controls, and
- Plan and implement land management strategies, if the PCS is not adequately controlled.

Please indicate your willingness to include this in your plan for managing future potential contamination sources.

7.0 Implementation Schedule

Since your report contains a commitment to maintaining best management practices, this section should give some indication of what kind of schedule will be followed. For example, if septic vaults are routinely pumped out, what is the frequency? If inventory checks and interstitial monitoring are made on above ground storage tanks, how often does this happen? Please offer some specifics in this section.

9.0 Recordkeeping Section

This section should discuss how records pertaining to your source protection plan will be keep. For example. when the fuel storage tank is checked, where will a record of that be kept? When the septic system is upgraded, where will that be noted? If and when you revise your report or add items to your inventory, where will those records be kept? Please expand on this area.

10.0 Contingency Plan

This section suggests that a Contingency Plan will be developed if and when a problem arises. A Contingency Plan should anticipate problems, and develop a strategy for dealing with a problem before it arises. You have suggested a few contingencies, which may be adequate, but please be aware that it is too late to plan after problems have developed.

Please call me at (801) 536-4206 if you have questions or concerns about the review of your DWSP plan. To help us serve you more efficiently, please use the water system number for Hovenweep National Monument in your correspondence.

Sincerely,

Kate Johnson, P.G.
Environmental Scientist
Special Services Section

KEJ

Cc: Larry Martin, NPS/WRD, 1201 Oakridge Drive, Suite 250, Ft. Collins, CO 80525

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Larry Martin
07/16/01 10:44 AM
MDT

To: Joe Joliet@NPS, Mike Hunter/CANY/NPS@NPS
cc: (bcc: Larry Martin/FTCOLLINS/NPS)
Subject: HOVE well source protection plan

I recently received a copy of a letter that was sent to Joe Joliet from Utah DEQ. The letter discussed several deficiencies in the source water protection plan I had prepared for HOVE. After reading this letter and thinking about it for a few days, I suggest that we do not respond at this time. Rather we put the letter in the files with the source protection plan and address the concerns of DEQ when the plan is reviewed in 5 years. I plan on still being here then. I would expect that we might eventually get similar letters for the source protection plans at NABR and CANY, since they were very similar.

My reasons for reaching this conclusion are;

1. Source protection plans for transient non-community water systems are not required by Utah DEQ. We undertook this project because we thought it was a good idea to conduct an inventory of potential contaminants and address whether management actions at each park are adequate to minimize the potential for contamination of the water source.

2. Item 3.0 in the letter notes that the only change necessary in the report would be to identify septic systems as uncontrolled potential contaminant sources. The letter goes on to say that routine pumping of septic tanks suffices as a management plan. We can address this concern by some simple rewording of this section.

3. Item 6.0 in the letter asks that we indicate our willingness to include in the report a couple of items related to managing future potential contaminant sources. Adding the suggested text would not appreciably change the report.

4. Item 7.0 asks that we be more specific regarding things like how often the septic vaults are pumped and how often the inventory checks and interstitial monitoring is conducted on the fuel storage tanks. Adding specific numbers to the plan will not appreciably change the report.

5. Item 9.0 asks that we be more specific regarding where records will be kept. For example, where the monitoring records for the fuel storage tanks are kept. This can be done when the plan is reviewed and revised in 5 years.

6. Item 10.0 asks that we develop a contingency plan. I think the report could be revised and this section reworded to address this concern.

The deficiencies identified by Utah DEQ are not major. Making the necessary changes to the source protection plan would be fairly simple, but would not appreciably change the plan or report, or the way the park operates. Therefore, I suggest that we wait to revise the report until the 5 year review. Perhaps there will be more changes to the Utah DEQ report requirements and format before then.

Mike,
I will make changes to the ARCH reports to address these concerns. As soon as I get your comments regarding the ARCH Headquarters well report, I will make revisions and get both of the ARCH reports published. I assume the report is on someone's desk at the park.

Larry

Larry Martin, Hydrogeologist
NPS- Water Resources Division
1201 Oakridge Dr., Suite 250

DEPARTMENT OF ENVIRONMENTAL QUALITY
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United States Department of the Interior
NATIONAL PARK SERVICE
Water Resources Division
1201 Oak Ridge Drive, Suite 250
Fort Collins, CO 80525

1-3-01

IN REPLY REFER TO

Joe Joliet
NABR/HOVE

Enclosed are the Source Water Protection Plans for drinking water supply wells at Hovenweep and Natural Bridges National Monuments. I have enclosed two copies of each plan, one copy for Maintenance Division files and one copy for the general park files. I also sent a copy to the Utah Division of Drinking Water. The distribution list for all copies is below.

If you have any questions or comments on these plans, please direct them to Larry Martin at the National Park Service's Water Resources Division.

Thank you,

Larry Martin
National Park Service
1201 Oakridge Drive, Suite 250
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(970)-225-3515

larry_martin@nps.gov

Distribution: Park Files
Maintenance Division Files at each park
Mike Hunter, SEUG
John Collins, Public Health Service
TIC Library, Denver
John Reber, IMR-Natural Resources
WRD Files

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EXECUTIVE SUMMARY

The Square Tower Unit of Hovenweep National Monument obtains its water from a deep well located at the maintenance/housing area. The well was drilled to 1440 feet deep and was constructed in 1963. Water is pumped from the Entrada and Navajo Sandstone Formations at depths of 1100-1150 and 1250-1400 feet below ground surface. The Entrada and Navajo Formation aquifers are confined (artesian) in this area. Groundwater in these aquifers is effectively protected from contamination from surface sources by several hundred feet of overlying shale layers and artesian aquifer conditions.

Available information does not allow us to delineate the area of groundwater flow to the well for various time periods, as prescribed by Utah Division of Drinking Water. Hydrologic data is inadequate to determine even the direction of groundwater flow. Therefore, we used the optional two-mile radius for developing this drinking water source protection plan.

There are few potential contaminants in the area. Most potential contaminant sources in the area are under the direct control of the National Park Service. Oil wells and a soil bioremeditation site are regulated by the Utah Division of Oil, Gas, and Mining.

The aquifer is protected from contamination by several thick intervals of shale formations between land surface and the perforated interval of the well. It is extremely unlikely that any contaminant spill could be so large or so prolonged as to allow infiltration to the Entrada and Navajo Sandstone Formations.

1.0 INTRODUCTION

Hovenweep National Monument was created to protect several archeological sites and ruins in the canyon country north of the San Juan River. The site is about 40 miles west of Cortez, Colorado and 45 miles northeast of Bluff, Utah. The location is shown on the map in Figure 1.

1.1 System Information

National Park Service
Hovenweep National Monument
Utah DEQ Number 19014

This is a transient, non-community public water supply system. The well was constructed in 1963 and has been in use continuously since then.

1.2 Source Information

There is only one drinking water supply well at Hovenweep National Monument. The well was constructed in 1963 and has been the sole source of water since then. The well is located immediately north of the maintenance and employee housing area. The land survey location is T39S, R26E, Section 21, SE¼ of NW¼. Land surface elevation at the well is approximately 5220 feet above mean sea level.

Water is used for drinking and restroom facilities for approximately 50,000 visitors per year. There are three employee residences at the park. The well also supplies water for a campground and visitor center.

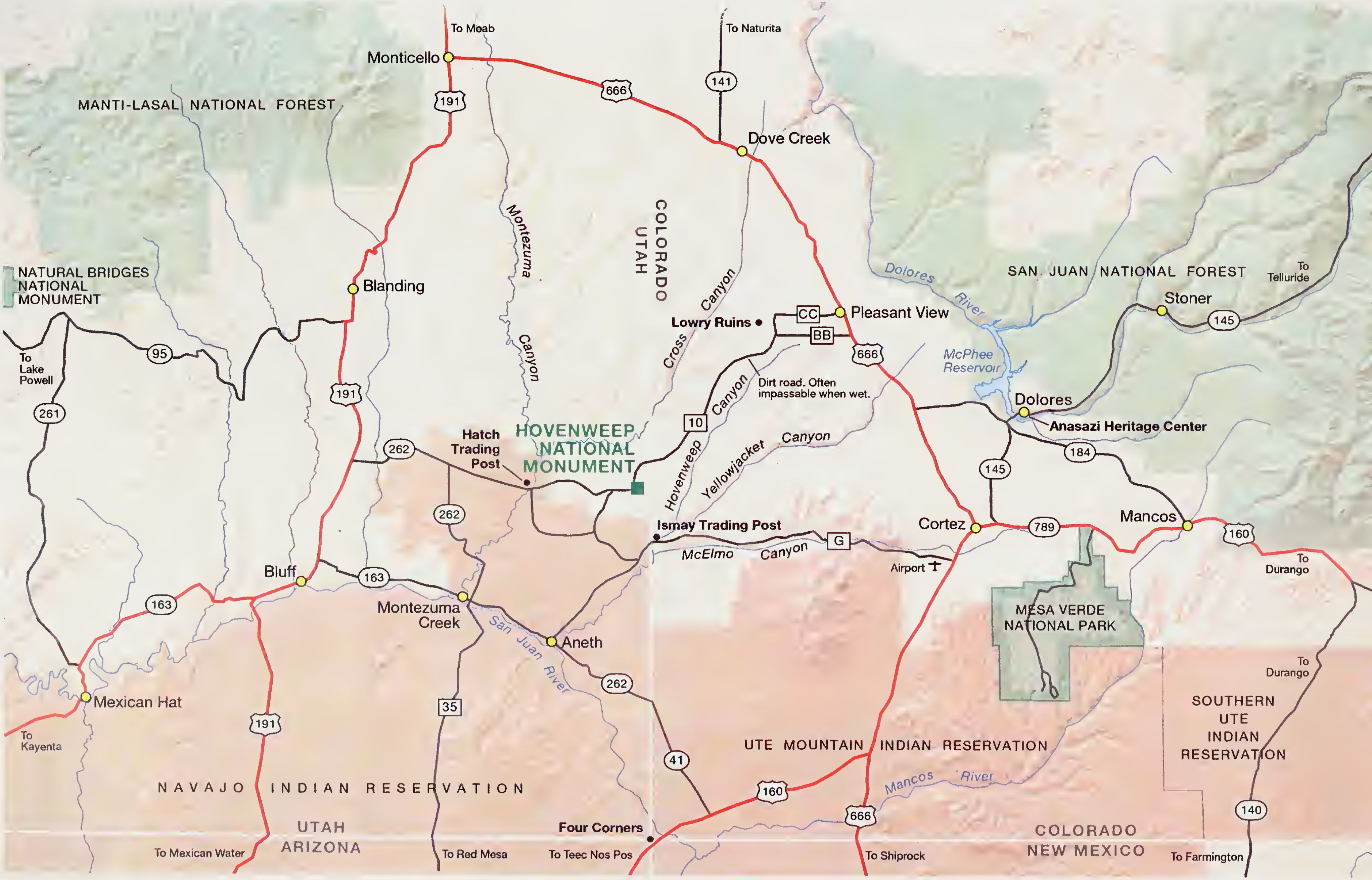


Figure 1. General Location Map

1.3 Designated Person - R309-113-5:

Owner: National Park Service
Superintendent: Palma Wilson Phone: (435)-692-1234
Operator: Joe Joilet Phone: (435)-692-1234
Address: c/o Natural Bridges National Monument
HC 60, Box 1
Lake Powell, UT 84533

2.0 THE DELINEATION REPORT - R309-113-9(5)

The primary source of hydrogeologic information for this report is an administrative report by the U.S. Geological Survey regarding construction and testing of the well in 1963. A driller's log and the well construction report provide additional information. Several other reports provide general information on the hydrogeology of this area. There are no other water supply wells within several miles of the site.

2.1 Geologic Data - R309-113-9 (5)(a)(i)

Hydrogeology

The geology in the vicinity of Hovenweep National Monument is fairly simple – a series of flat-lying rock formations extending for tens of miles in all directions. There is only minor folding or faulting. The Dakota Sandstone is at the surface and is underlain by the following formations: Burro Canyon Formation at 90 feet, Morrison Formation at 150 feet, Bluff Sandstone at 785 feet, Summerville Formation at 960 feet, Entrada Sandstone at 1080 feet, Carmel Formation at 1200 feet, and the Navajo Sandstone at 1225 feet. During drilling of the well, water-bearing zones were encountered at several

depths in the Morrison Fm. and in the Bluff, Entrada, and Navajo Sandstones. The aquifers in the Bluff Sandstone and Morrison Fm. produced only small quantities of water. Sufficient quantities of water were found in the lower two sandstone formations, the Entrada and Navajo. The lithologic and geologic logs for the well are shown in Table 1.

Table 1. Lithologic and Geologic Log of Water Supply Well, Hovenweep National Monument

Footage			
From	To	Description	Geologic Formation
0	20	Brown sandstone	Dakota Sandstone
20	60	Red Sandstone	
60	70	Coal and shale	
70	85	Sandstone with streaks of coal	
85	90	Blue sandstone	
90	135	Blue shale	Burro Canyon Fm.
135	150	Shale with streaks of sandstone	
150	175	White sandstone – Water	Morrison Fm.
175	180	Blue shale	
180	193	Red shale	
193	235	Blue sandstone	
235	255	Blue shale	
255	400	Red and blue shale	
400	415	White sandstone	
415	420	Blue shale	
420	460	White sandstone – trace of water	
460	468	Blue shale	
468	510	Sandstone	
510	532	Red and green shale	
532	550	Brown sand	
550	560	Red shale	
560	575	Sandstone	
575	585	Red shale	
585	600	Sandstone	
600	784	Red shale with streaks of sandstone	
784	855	Sandstone – water sample	Bluff Sandstone
855	995	Red shale	
995	1020	Red sandstone – water sample	Summerville Fm.
1020	1070	Red sandstone	
1070	1103	Hard red sandstone	Entrada & Carmel Fm.
1103	1223	White sandstone – some water	
1223	1313	Red sandstone	Navajo Sandstone
1313	1440	Sandstone with streaks of shale	

The well casing is perforated in the Entrada Formation and Navajo Sandstone at intervals of 1100 – 1150 and 1250 – 1440 feet.

The Morrison and Summerville Formations are generally confining layers (Taylor and Hood, 1988), although there may be locally important aquifers within the Morrison at some locations. Static water level in the well at Hovenweep is 113 feet below ground surface. The shales overlying the Entrada and Navajo Formation aquifers form effective confining layers as evidenced by the artesian pressure which allows water from aquifers over 1100 feet deep to rise to within 113 feet of land surface. Regional groundwater flow in the Mesozoic aquifers in this area is generally toward the southwest (Avery, 1986)

There are no other water wells within two miles of Hovenweep National Monument. Land use in the area surrounding the monument is primarily light grazing of cattle and sheep. There is very little water available for animals, which greatly limits the amount of grazing. Natural precipitation in the area averages 8-10 inches per year, which limits the growth of forage for grazing.

Water Quality

Water quality samples were collected from the well during the drilling and testing in 1963-4. Subsequent sampling in 1999 shows no significant change in water quality. The sample collected in 1999 was analyzed for a suite of volatile organic compounds, but none were found above detection limits. Chemical analyses are summarized in Table 2. Copies of the lab data sheets for the 1999 samples are in the appendices of this report.

Table 2. General water quality.

Date	9/7/63	6/22/64	3/10/64	2/22/99
Ca (mg/l)	18	4	13	18.5
Mg (mg/l)	7.3	7	7.5	8.4
Na (mg/l)	418	370		317
K (mg/l)	22	40		23
HCO_3 (mg/l)	755	527	644	620
CO_3 (mg/l)	0	58	15	0
SO_4 (mg/l)	297	295	299	218
Cl (mg/l)	56	45	28	16
NO_3 (mg/l)	.7	1.7	0.2	<0.1
TDS (mg/l)	1200	1130	1070	924
Hardness ($CaCO_3$)	75	38	64	81
Spec. Cond. (umhos)	1820	1745	1630	1420
pH	7.9	9.3	8.4	8.0

In general, the water quality is fair. It could be used without treatment, but concentrations of iron, sulfate, and sodium are high enough to cause discoloration of plumbing fixtures and taste or odor concerns. Water for drinking is treated with individual reverse osmosis units in each house. The only treatment for water supplied to the campground is chlorination.

2.2 Well Construction Data - R309-113-9 (5)(a)(ii) & (iii)

The well was constructed by Express Drilling Company of Littleton, Colorado. Construction was started on May 23, 1963 and completed on September 25, 1963. The well was drilled by cable tool method. Ten-inch casing was set from 2 feet above ground to 200 feet, eight-inch casing from 160-1000 feet, and six-inch casing from 960-1425 feet. The six-inch casing was perforated with a cutting torch before installation in the intervals from 1150-1200 and 1275-1425 feet. A 10-foot cement surface seal was installed at the surface. Land surface elevation at the well is approximately 5220 feet above sea level. The pump is set at a depth of 240 feet and produces 11 gpm.

2.3 Aquifer Data - R309-113-9 (5)(a)(iv)

Drawdown and yield testing were conducted on September 6-7, 1963. The water level was 131 feet below land surface when pumping began. After 9 hours of pumping and 11 hours of recovery, the water level was 113 feet below ground surface, indicating that the well was being developed during pumping. On September 7, 1963, the well was pumped for 5 hours at a rate of 29 gpm. The drawdown at the end of this period was 140 feet. This discharge was the maximum amount possible with the available pump. An electric probe was used to measure the depth to water and a 3-inch parshall flume was used to measure discharge. The specific capacity of the well was determined to be 0.2 gpm per foot of drawdown after 5 hours of pumping. The current pumping rate of the well with the existing pump is 11 gpm.

2.4 Hydrogeologic Methods, Procedures, and Calculations - R309-113-9 (5)(a)(vii)

Data collected during the testing of the well in 1963 are not suitable for computation of aquifer parameters; transmissivity, hydraulic conductivity, or storage coefficient. No additional monitor wells have been constructed in the area. There are no other water supply wells in the area. Therefore, conducting a new performance test would not provide data that could be used to calculate aquifer characteristics. There are insufficient wells in the area to determine the direction of groundwater flow. Since the area is remote and there are few potential contaminant sources, the optional two-mile radius delineation will be used to delineate the wellhead protection area.

2.5 Map Showing Boundaries of the DWSP Zones - R309-113-9 (5)(a)(viii)

Figure 2 is a map showing the area within two miles of the supply well.

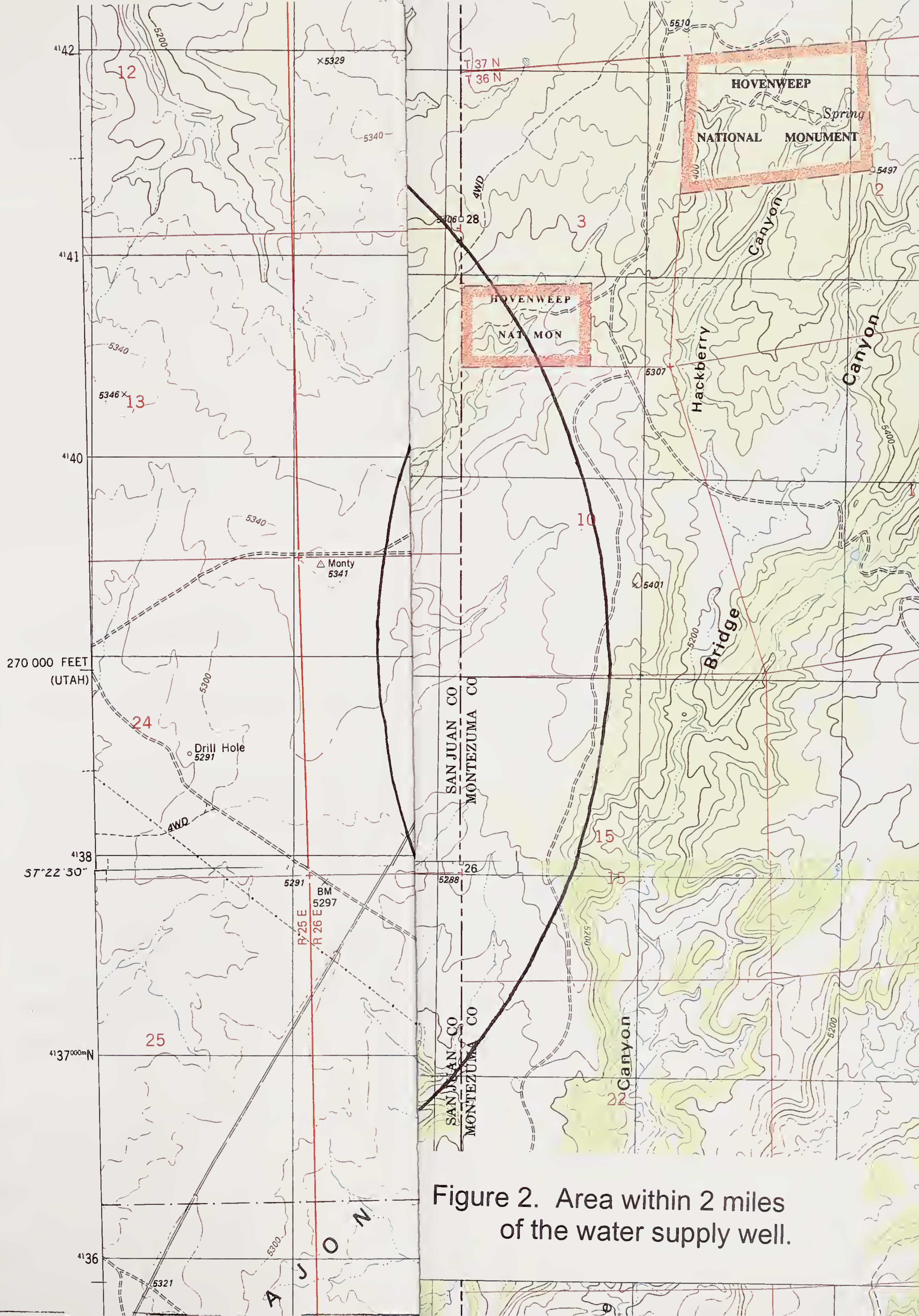


Figure 2. Area within 2 miles of the water supply well.

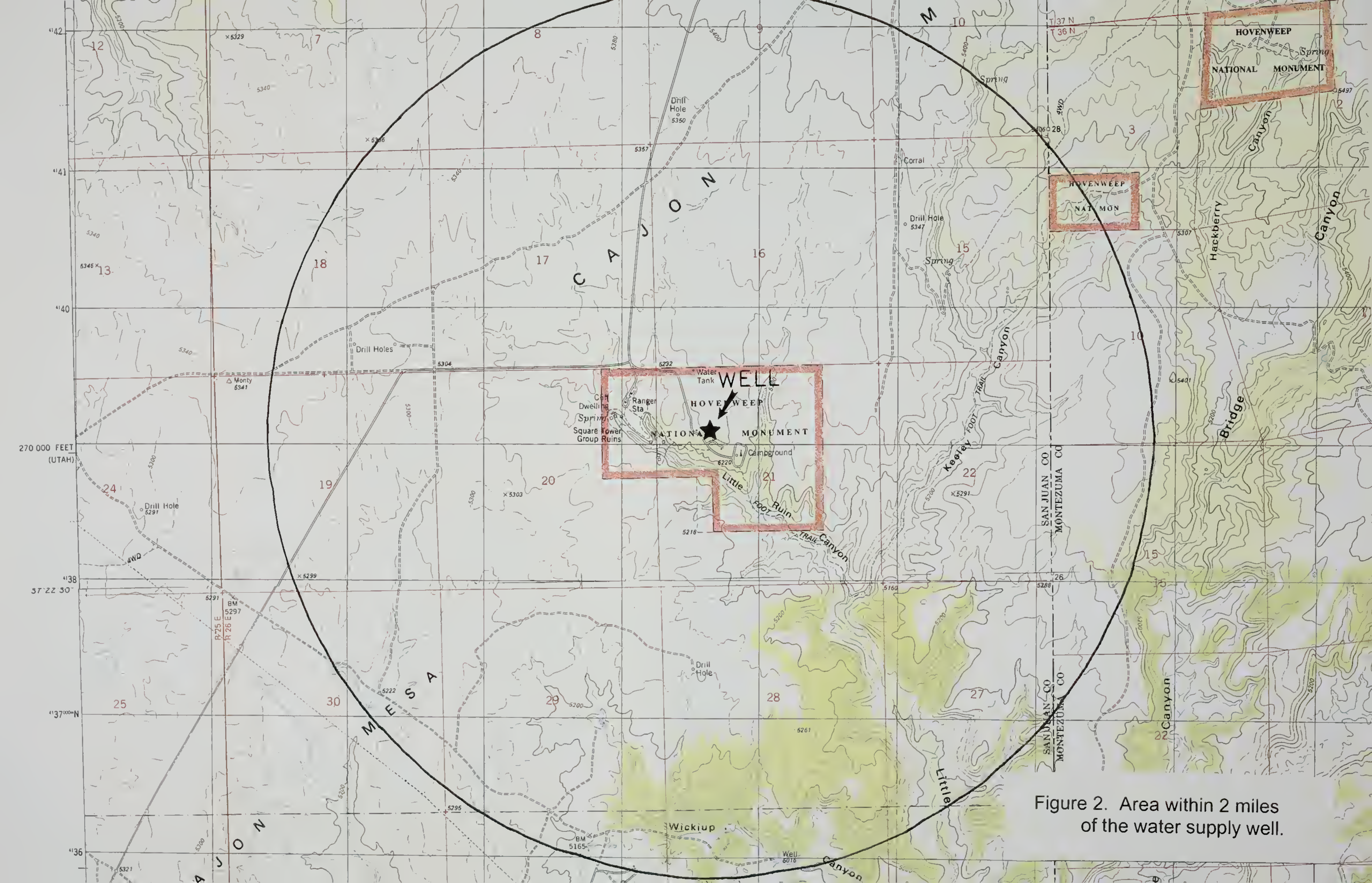


Figure 2. Area within 2 miles of the water supply well.

2.6 Protected or Unprotected Aquifer Classification – R309-113-9(3) & (6)

This well does not meet all of the criteria for classification as a protected aquifer, as described in the Utah DEQ guidelines for source water protection plans. However, from a practical standpoint, this is a protected aquifer. The cumulative shale thickness in overlying geologic formations exceeds 600 feet. Artesian pressure in the Entrada and Navajo Sandstones at this site causes water to rise in the well to within about 113 feet of land surface, an artesian pressure of nearly 1000 feet above the top of the aquifer. This upward gradient, combined with the large thickness of shale, should effectively prevent any contaminants accidentally spilled or released at the surface from reaching the aquifer.

3.0 THE INVENTORY OF POTENTIAL CONTAMINATION SOURCES - R309-113-10

3.1 List Possible Potential Contamination Sources - R309-113-10 (1)

Possible potential contaminant sources within two miles of the well include: sewer lines and septic leachfields, fuel tanks at the park, and small quantities of paint, oil, fuel, solvents, insecticides, and herbicides in the maintenance shop at the park. There is a soil bioremediation site approximately 1½ miles northwest of the well. There are several plugged and abandoned oil wells surrounding the park and one active oil production well 1½ miles north of the water supply well. There is an approved application for construction of another oil production well 1½ miles north of the water supply well.

3.2 Identify Hazards:

Potential contaminant sources, hazardous substances associated with each of the possible potential contaminant sources, and approximate quantities of each hazardous substance are listed in Table 3.

Table 3. Hazardous substances associated with each potential contaminant source

Potential Source	Hazardous Substances	Approximate Quantity
Fuel Tanks	gasoline	One 1000-gallon tank, above ground.
Sewer lines Septic leachfields	Sewage	One septic system services the Maintenance Shop, 3 residences and the campground. A second septic system services the Visitor Center.
Maintenance shop	solvents, degreasers	Small quantities in 1-5 gallon containers.
	oil, waste oil	Several small containers (1-5 gallons each).
	paint	Approximately 10 1-gallon cans.
Oil wells	hydrocarbons	unknown
Soil bioremediation site	hydrocarbons	unknown

3.3 Prioritize the Inventory - R309-113-10 (1)

The 1000-gallon fuel storage tank presents the greatest threat to the public water supply at Hovenweep. The tank is a CONVAULT™, a double-wall steel tank encased

in concrete. Monitoring of the interstitial area between the steel walls provides for an early warning system if a leak should occur.

Potential contaminants stored in the Maintenance Shop are used or stored in small quantities and do not have a pathway to enter the aquifer.

Leachate from the septic system does not have a pathway to infiltrate through the large cumulative thickness of shale overlying the aquifers. The park is planning to replace and upgrade the septic tank and leachfield.

3.4 Potential Contamination Source Location - R309-113-10 (1)

The fuel storage tank and various containers of paint, oil, fuel, degreasers, etc. at the Maintenance Shop are probably located in Zone 1, the area within 100 feet of the well. The septic leachfield is more than 100 feet from the well. There are no other potential contaminant sources within a mile of the well.

A soil bioremediation site is on private land about 1½ miles northwest of the water supply well. Soil contaminated with crude oil from oilfields and crude oil storage sites are brought to the site and allowed to undergo natural bioremediation.

There are several abandoned oil wells within two miles of the water supply well. There is one active well and one well approved for construction. Both of these wells are about 1½ miles north of the water supply well.

3.5 Potential Contamination Sources Plotted on Map

Potential contamination sources are plotted on the map in Figure 3.

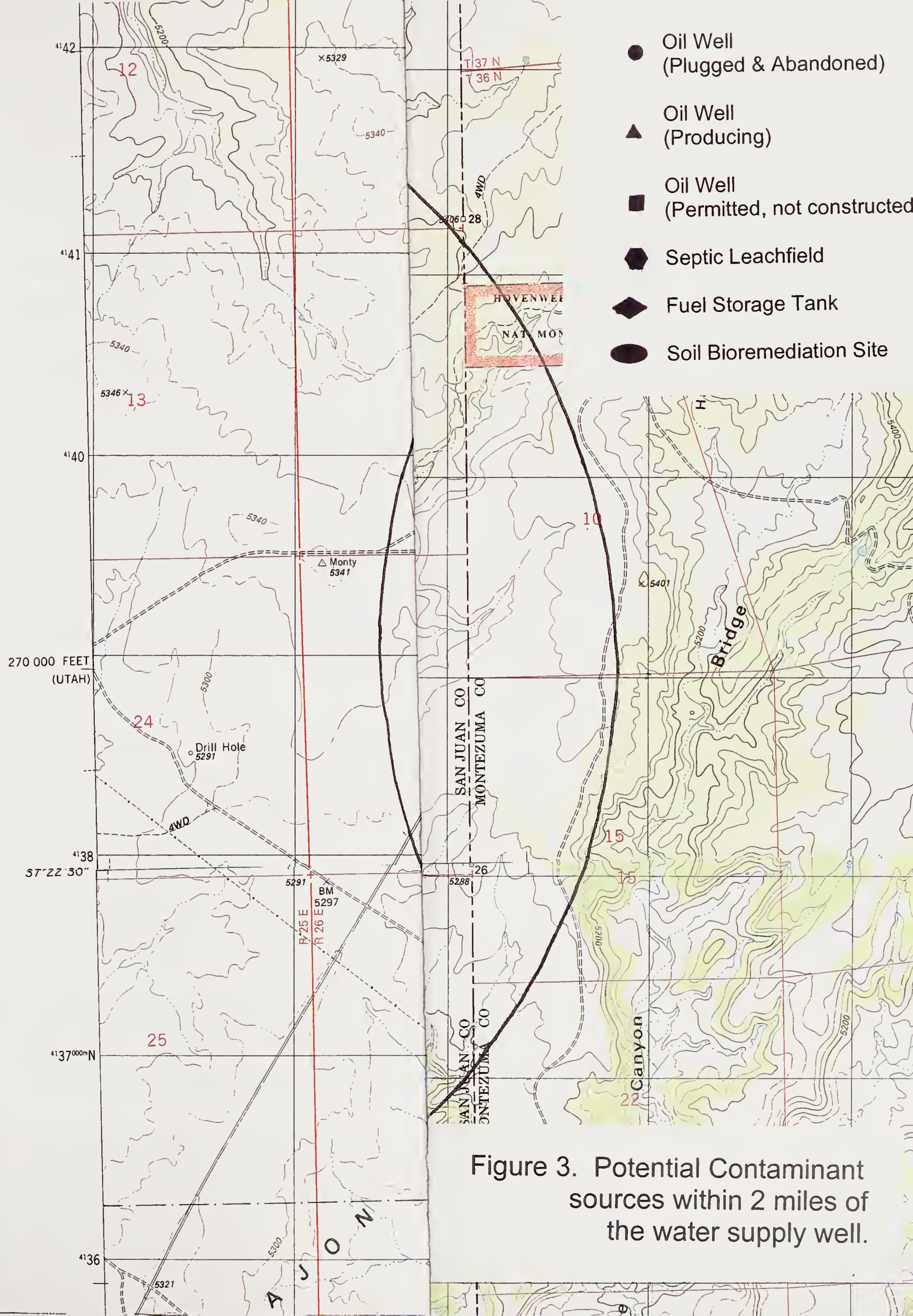


Figure 3. Potential Contaminant sources within 2 miles of the water supply well.

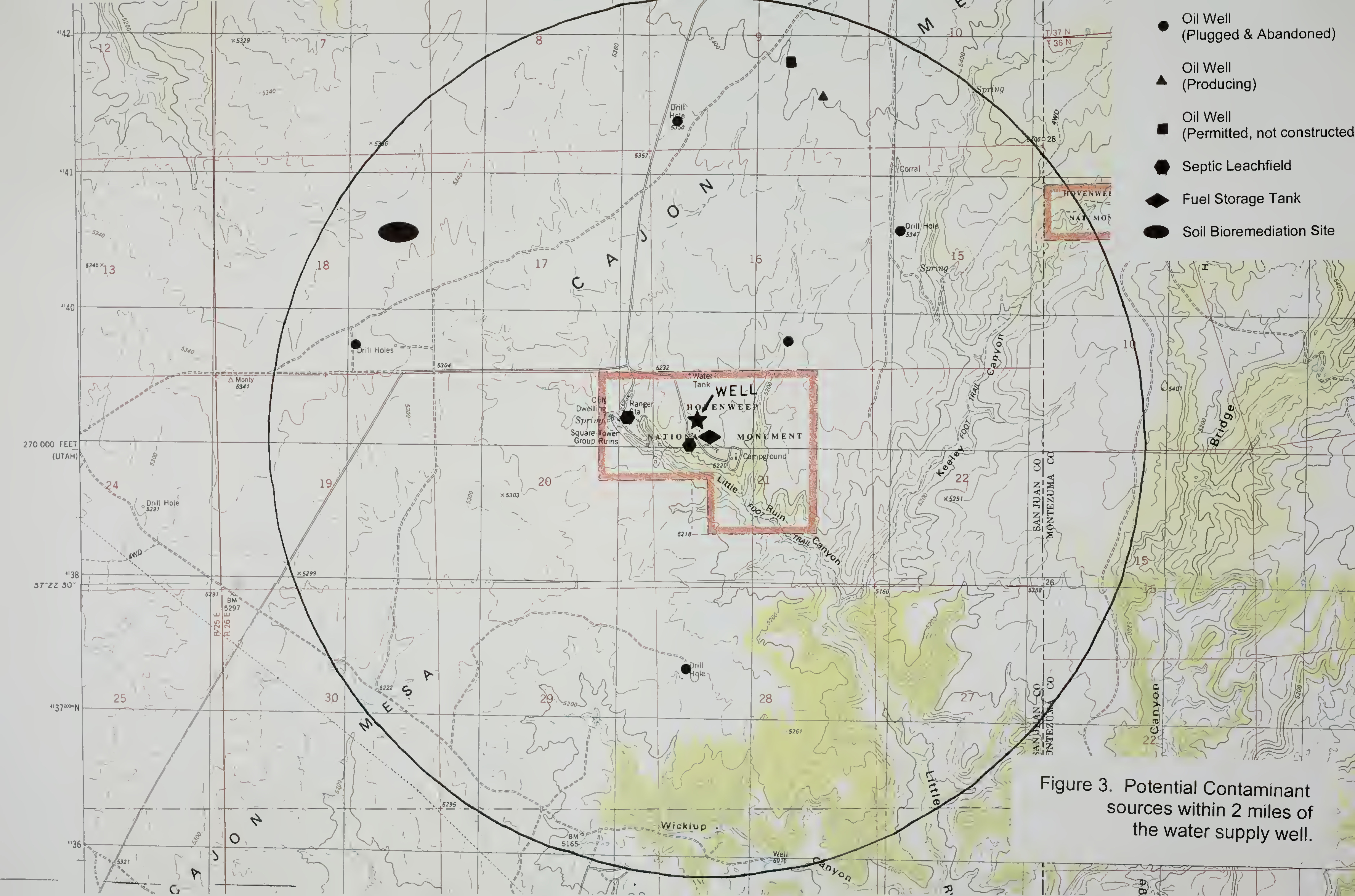


Figure 3. Potential Contaminant sources within 2 miles of the water supply well.

4.0 THE ASSESSMENT OF POTENTIAL CONTAMINATION SOURCE HAZARDS

There are several thick shale layers in the 1000+ feet between the surface and the aquifers supplying water to the well. Cumulative thickness of the shale exceeds 600 feet. The large thickness of shale should prevent any accidental spills or releases at the surface from reaching the aquifer.

There are no concentrated sources or large volumes of potential contaminants within two miles of the well. The area is remote and rural. Land use is primarily grazing and visitor use at the national park. Potential contaminants at the park are primarily associated with the maintenance shop, including fuel storage tanks. Solvents, degreasers, paint, and similar materials (which might be classified as hazardous) are purchased and stored in small quantities, reducing the potential for release of large quantities of contaminants.

Potential contaminant sources are adequately controlled through a combination of hydrogeologic conditions and regulatory, operational, physical, and negligible quantity controls; as described in the following paragraphs of this section.

Septic leach fields have been designed and constructed according to state or local requirements. Sludge is pumped from septic tanks on a regular basis.

Contents of the fuel storage tank are monitored on a routine basis. Inventory is closely monitored to insure that any leaks are identified quickly. The tank is above ground. The tank is double-walled steel encased in concrete.

The soil bioremediation site is located about 1½ miles northwest of the water supply well. Surface drainage at the site is toward the northwest, away from the water supply

well. Berms have been constructed to prevent runoff from soil undergoing bioremediation. The site is underlain by about 150 feet of clayey soil (personal communication, Brad Hill, Utah Division of Oil, Gas, and Mining, December 27, 2000). The site is regulated by the Utah Division of Oil, Gas, and Mining.

There are five plugged and abandoned oil wells within two miles of the water supply well. Tere is one active oil well and one additional well approved for construction. Plugging and abandonment and construction of new wells, including cement casing seals, is regulated by the Utah Division of Oil, Gas, and Mining. The target zone for oil wells in this area is generally 6000-6500 feet below ground surface, more than 4000 feet deeper than the production zone for the water supply well.

The park will continue to follow Best Management Practices, as described above. These practices will reduce the potential for accidental release of potential contaminants on the surface or near-surface in the vicinity of the supply well. Combined with the large thickness of shale formations and artesian aquifer conditions, these practices should provide adequate protection for the water supply well.

Potential hazards at this site are adequately controlled and no further land management strategies will be planned or implemented, unless conditions change.

5.0 THE MANAGEMENT PROGRAM FOR EXISTING POTENTIAL CONTAMINATION SOURCES - R309-113-11

Current land use and land management practices are adequate to prevent the accidental spill or release of potential contaminants. No additional management actions are required at this site.

Contents of the fuel storage tank are routinely monitored. The tank is above ground so any leakage would be readily apparent. The sewage collection system and septic leachfield are constructed to comply with applicable state and local regulations and standards. Oil, fuel, solvents, paint, etc. stored in the maintenance shop are limited to quantities that will be used within a reasonable time. These materials are stored on shelves or a concrete floor. Spills or leaks are readily apparent and cleaned up in an appropriate manner.

Construction and abandonment of oil wells and the operation of the soil remediation site are regulated by the Utah Division of Oil, Gas, and Mining. Operation of these facilities in compliance with existing regulations should adequately prevent contamination of the aquifer supplying the park's water supply well.

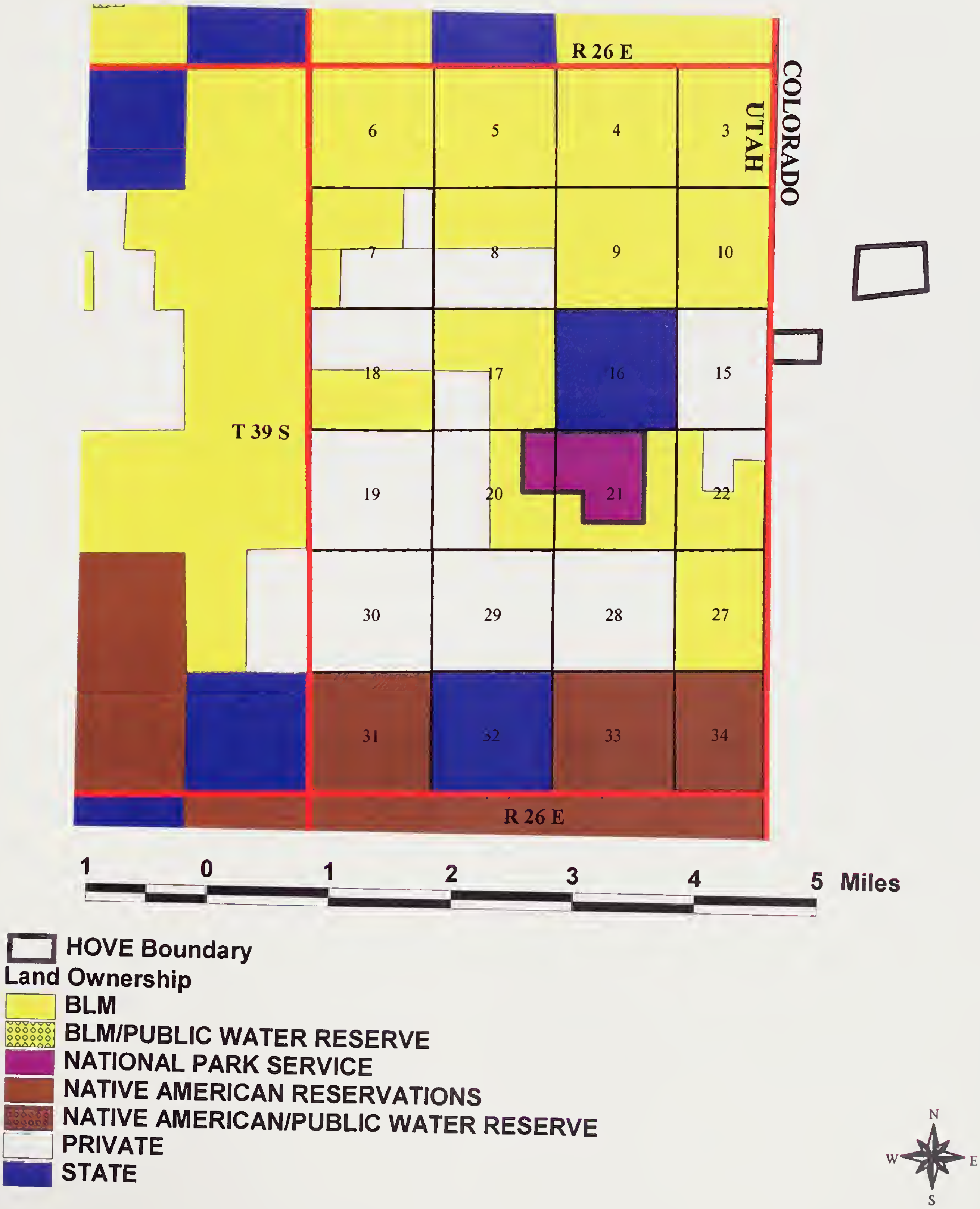
6.0 THE MANAGEMENT PROGRAM FOR FUTURE POTENTIAL CONTAMINATION SOURCES - R309-113-12

6.1 Management Program - R309-113-13 (4)

If there are any proposed changes to current land use and land management practices within two miles of the well, the National Park Service will review those proposed changes to determine whether the proposed change might have a deleterious impact on the water supply for the park. No such changes are anticipated, as the area is remote and rural.

The land immediately adjacent to the monument is owned by the federal government and managed by BLM or Utah State public land (Figure 4). Private land is generally more than a mile from the well. Surface drainage toward the well is generally limited to federal and state owned land.

Figure 4
Hovenweep National Monument
Property Ownership



7.0 THE IMPLEMENTATION SCHEDULE - R309-113-7 (1)(e)

No new land management strategies will be implemented under this plan. The aquifer supplying water for Hovenweep National Monument is adequately protected by hydrogeologic conditions and existing land use management practices.

8.0 THE RESOURCE EVALUATION - R309-113-7 (1)(f)

No additional financial or other resources will be required to implement this Drinking Water Source Protection Plan. All potential contaminant sources are currently adequately controlled. Hydrogeologic conditions provide further protection of the aquifer from potential contamination. Land use and ownership in this remote area makes it likely that no potential contaminant sources would ever be located within the source area for this well.

9.0 THE RECORDKEEPING SECTION - R309-113-7 (1)(g)

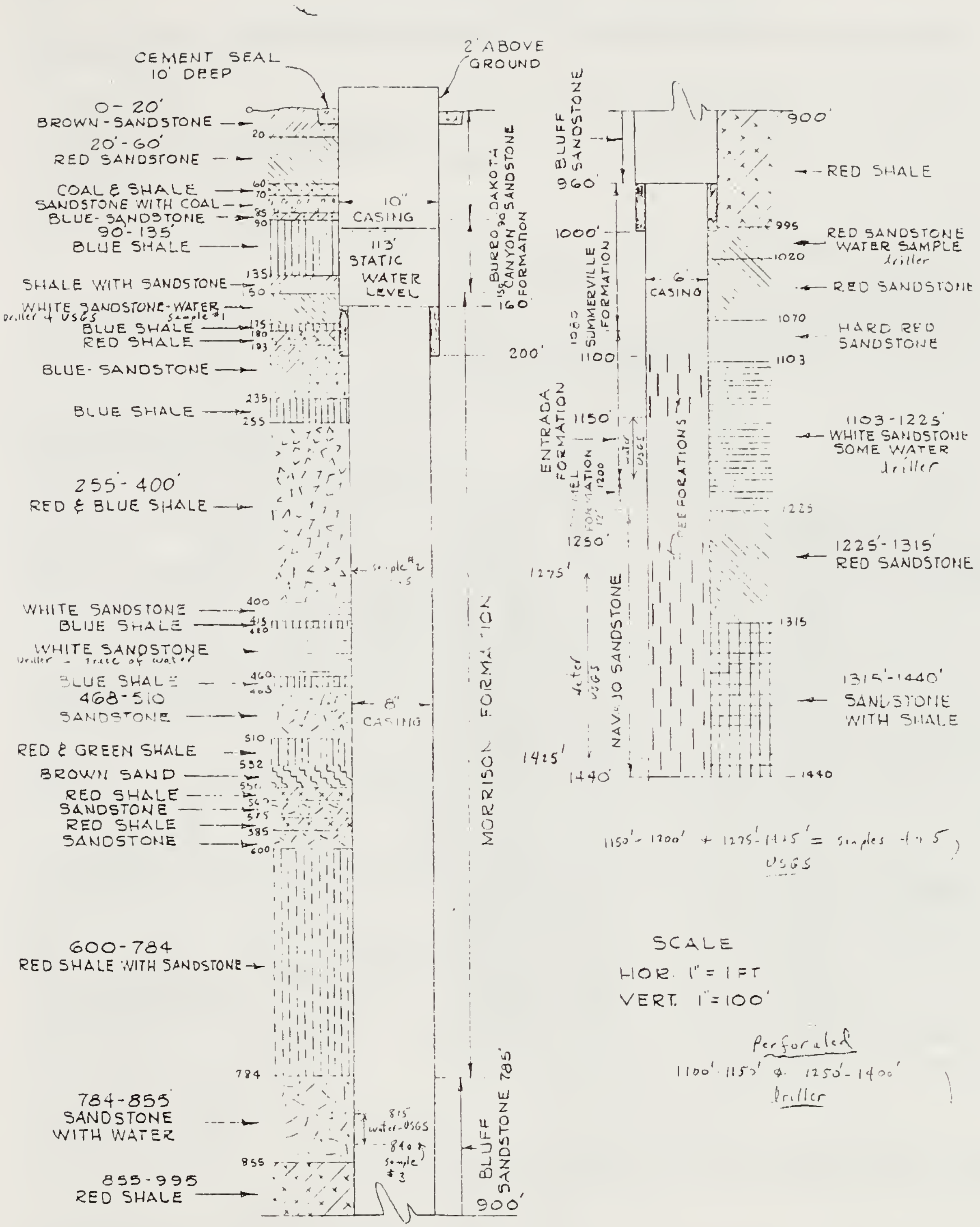
This plan was developed by National Park Service staff. The plan will be reviewed and updated, as necessary, in 5 years, December 2005.

10.0 THE CONTINGENCY PLAN - R309-113-14

There is only one well available to supply water to the system at Hovenweep National Monument. A specific contingency plan will only be developed if a problem arises in the future. Remedial action would depend on the source and nature of the problem. There are no other freshwater aquifers underlying the site that could be used as alternative water sources. Should the entire aquifer become contaminated, it would be necessary to pipe or truck water from some other source, several miles distant. If only a small part of the aquifer near the well is contaminated, a new well could be constructed a suitable distance away from the contaminated area.

Bottled water would be supplied to the park residents and to park staff and visitors as necessary, should the water supply become contaminated.

Appendices



WELL LOG

Application 34788

Started May 23, 1963 & Completed September 25, 1963

By Express Drilling Co.

HOVENWEEP NATIONAL MONUMENT

BASIC DATA. Report of Ted. A Holland of Express
Drilling Co 1/14/64, By C. Arquero 1/24/64.

Form 113-[illegible]-12-60

Received

Recorded: B C

Inspection Sheet

Copied

T B

REPORT OF WELL DRILLER

STATE OF UTAH

Application No. 34788

Claim No.

Coordinate No.

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:

Name U.S. NATIONAL PARK SERVICE

Address P.O. Box. 1728 SANTA FE, N.M.

(2) LOCATION OF WELL:

County SAN JUAN Ground Water Basin (leave blank)

~~North~~ South 46° 20' ~~feet~~ East ~~West~~ 2208.7 feet from NW Corner

of Section 21, T 39 ~~N~~ S, R 26 E SLBM ~~USM~~ (strike out words not needed)

(3) NATURE OF WORK (check):

New Well ☒ Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐

If abandonment, describe material and procedure

(4) NATURE OF USE (check):

Domestic ☒ Industrial ☐ Municipal ☐ Stockwater ☐

Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):

Rotary ☐ Dug ☐ Jetted ☐

Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded ☒

10 " Diam. from 0 feet to 200 feet Gage 40.48

8 " Diam. from [illegible]0 feet to 1200 feet Gage 28.55

6 " Diam. from 960 feet to 1440 feet Gage 18.97

New ☒ Reject ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☒ No ☐

Type of perforator used

Size of perforations 1/4" inches by 3" inches

8.7a perforations from 1100 feet to 1150 feet

Surface perforations from 1250 feet to 1400 feet

perforations from feet to feet

perforations from feet to feet

perforations from feet to feet

(8) SCREENS: Well screen installed? Yes ☐ No ☒

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to

Diam. Slot size Set from ft. to

(9) CONSTRUCTION:

Was well gravel packed? Yes ☐ No ☒ Size of gravel:

Gravel placed from feet to feet

Was a surface seal provided? Yes ☒ No ☐

To what depth? 20 feet

Material used in seal: Cement

Did any strata contain unusable water? Yes ☐ No ☒

Type of water: Depth of strata

Method of sealing strata off:

Was surface casing used? Yes ☒ No ☐

Was it cemented in place? Yes ☒ No ☐

(10) WATER LEVELS:

Static level 113 feet below land surface Date

Artesian pressure feet above land surface Date

LOG RECEIVED:

(11) FLOWING WELL:

Controlled by (check) Valve ☐

Cap ☐ Plug ☐ No Control ☐

Does well leak around casing? Yes ☐ No ☐

(12) WELL TESTS:

Drawdown is the distance in feet the water level is lowered below static level

Was a pump test made? Yes ☒ No ☐ If so by whom?

Yield 29 gal./min. with 140 feet drawdown after 5 hours

Estimate 50 " 250 " 5 "

Bailer test gal./min. with feet drawdown after hours

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? No ☐ Yes ☒

(13) WELL LOG:

Diameter of well 12"-10"-8" inches

Depth drilled 1440 feet Depth of completed well 1440 feet

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH From	DEPTH To	Clay	Silt	Sand Stone	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other Shale	REMARKS
0	60			X								Brown & Red
60	70										X	Streaks Coal
70	90			X								Blue
90	150										X	Streaks of Sandstone
150	175			X								White
175	193										X	Blue
193	225			X								Blue
225	255										X	Blue
255	400										X	Red & Blue
400	415			X								White
415	420										X	Blue
420	460			X								White (Trace of water)
460	468										X	Blue
468	510			X								
510	550										X	Sand streaks
550	560										X	Red
560	575			X								
575	585										X	Red
585	784			X								Streaks Shale
784	855			X								Trace of water
855	995										X	Red
995	1020			X								Trace of water
1020	1070			X								Red
1070	1103			X								Hard
1103	1225			X								White
1225	1315			X								Red
1315	1440			X								Streaks Sand

Work started May 23, 1963 Completed Sept 25, 1963

(14) PUMP:

Manufacturer's Name

Type H. P.

Depth to pump or bowles feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name Express Drilling Company (Person, firm, or corporation) (Type or print)

Address 5946 Sumner St Littleton, Colorado

(Signed) Ted Holland (Well Driller)

License No. 2414 Date Jan 10, 1963

USE OTHER SIDE FOR ADDITIONAL REMARKS

UTAH STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

HOVENWEEP NATIONAL MON.

Lab Number: 9901287 Sample Type: 04 Cost Code: 361B
Description: HOVENWEEP NATIONAL MONUMENT

Site ID: 19014	Source No: 00	Organic Review:	
Sample Date: 02/22/99	Time: 14:00	Inorganic Review:	03/29/99
		Radiochemistry Review:	03/22/99
Tot. Cations: 367 mg/l	16.0 me/l	Microbiology Review:	
Tot. Anions: 534 mg/l	14.7 me/l		
Grand Total: 901 mg/l	%D = 4.2		

TEST RESULTS:

L-pH *	7.97	T.Sus.Sol	<4.0 mg/l
NO2+NO3, N	<0.1 mg/l	Cyanide	<0.01 mg/l
Ammonia N	0.23 mg/l	D-Calcium	18.5 mg/l
D-Magnesum	8.38 mg/l	D-Potassum	23.1 mg/l
D-Sodium	317.0 mg/l	Bicarbnate	620 mg/l
Carb. Diox	11 mg/l	Carbonate	0 mg/l
Fluoride	1.26 mg/l	Hydroxide	0 mg/l
SIO2	11.1 mg/l	Sulfate	218.1 mg/l
T. Phos.	<0.02 mg/l	Tot. Alk.	508 mg/l
T. Hardns.	80.6 mg/l	Surfactant	<0.015 mgLAS
Turbidity *	6.65 NTU	L-Sp. Cond	1420 umhos
TDS @ 180C	924 mg/l	T-Aluminum	<30 ug/l
T-Arsenic	17.0 ug/l	T-Barium	0.028 mg/l
T-Berylium	<1 ug/l	T-Cadmium	<1 ug/l
T-Chromium	18.0 ug/l	T-Copper	<12.0 ug/l
T-Iron	1.7 mg/l	T-Lead	<3.0 ug/l
T-Mangan	27.0 ug/l	T-Mercury	<0.2 ug/l
T-Nickel	<10.0 ug/l	T-Selenium	<1.0 ug/l
T-Silver	<2.0 ug/l	T-Zinc	<30.0 ug/l
T-Boron	284.0 ug/l	Color	1 ccu
T-Antimony	<3.0 ug/l	Odor	1.5 T.O.N
T-Thallium	<1.0 ug/l	CO3 Solids	305 mg/l
Corosivity	0.34 L.Ind	ChlorideIC	16.157 mg/l

QUALIFYING COMMENTS (*) on test results:

L-pH...... pH should be performed as a field test.

MAY EXCEED UTAH PRIMARY DRINKING WATER STANDARDS
for one or more of the results marked with an "*".

TEST and UTAH RULE summarized below:
Turbidity. Current STATE of UTAH maximum MCL is 5 NTU per Liter.

UTAH STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Hovenweep N.M.

Lab Number: 9901385 Sample Type: 04 Cost Code: 361B
Description: P3 WELL HEAD

Site ID: 19014 Source No: 00
Sample Date: 02/22/99 Time: 14:00

Organic Review:
Inorganic Review: 03/10/99
Radiochemistry Review:
Microbiology Review:

TEST RESULTS:

NO2+NO3, N	<0.1 mg/l	Sulfate	218.8 mg/l

QUALIFYING COMMENTS (*) on test results: NO COMMENTS

COMPLIES WITH PRIMARY DRINKING WATER STANDARDS
for all Test Results listed above, unless
indicated otherwise by a handwritten comment.

For Drinking Water Regulatory Compliance Information please call:
Division Of Drinking Water/Compliance (801)536-4200

END OF REPORT

UTAH STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Hovenweep N.M.

Lab Number: 9901386 Sample Type: 04 Cost Code: 361B
Description: P3 WELL HEAD

Site ID: 19014 Source No: 00
Sample Date: 02/22/99 Time: 14:00

Organic Review:
Inorganic Review: 02/25/99
Radiochemistry Review:
Microbiology Review:

TEST RESULTS:

Alpha, grs * 12.9 pCi/l +/-3.1

QUALIFYING COMMENTS (*) on test results: NO COMMENTS

MAY EXCEED UTAH PRIMARY DRINKING WATER STANDARDS
for one or more of the results marked with an "*".

TEST and UTAH RULE summarized below:
Alpha, grs In excess of 5.0 pCi per Liter requires testing for Radium 226.

For Drinking Water Regulatory Compliance Information please call:
Division Of Drinking Water/Compliance (801)536-4200

END OF REPORT

Hovenweep N.M.

Cost Code: 361B

EPA METHOD 524.2 GC/MS
Purgeables

Lab # 9901384

Utah Division of Laboratory Services
46 North Medical Drive
Salt Lake City, UT 84113

Date/Time Collected: 02/22/99 14:00
Sample Matrix: Water
Collected By: STAN WHITE
Sampling Site: 19014
Description of Sampling Point: HOVENWEEP NATIONAL MONUMENT

Analyst: R.L
Date Received: 02/23/99
Date Analyzed: 3/2/99

Regulated	MRL	Results ug/L	List 1	MRL	Results ug/L
Benzene	0.5	U	Chloroform	0.5	U
Carbon Tetrachloride	0.5	U	Bromodichloromethane	0.5	U
1,2-Dichloroethane	0.5	U	Chlorodibromomethane	0.5	U
1,1-Dichloroethylene	0.5	U	Bromoform	0.5	U
Para-Dichlorobenzene	0.5	U	m-Dichlorobenzene	0.5	U
1,1,1-Trichloroethane	0.5	U	1,1-Dichloropropene	0.5	U
Trichloroethylene	0.5	U	1,1-Dichloroethane	0.5	U
Vinyl Chloride	0.5	U	1,1,2,2-Tetrachloroethane	0.5	U
o-Dichlorobenzene	0.5	U	1,3-Dichloropropane	0.5	U
cis 1,2-Dichloroethylene	0.5	U	Chloromethane	0.5	U
trans 1,2-Dichloroethylene	0.5	U	Bromomethane	0.5	U
1,2-Dichloropropane	0.5	U	1,2,3-Trichloropropane	0.5	U
Ethylbenzene	0.5	U	1,1,1,2-Tetrachloroethane	0.5	U
Monochlorobenzene	0.5	U	Chloroethane	0.5	U
Styrene	0.5	U	2,2-Dichloropropane	0.5	U
Tetrachloroethylene	0.5	U	o-Chlorotoluene	0.5	U
Toluene	0.5	U	p-Chlorotoluene	0.5	U
Xylenes (total)	0.5	U	Bromobenzene	0.5	U
Dichloromethane	0.5	U	cis-1,3-Dichloropropene	0.5	U
1,2,4-Trichlorobenzene	0.5	U	trans-1,3-Dichloropropene	0.5	U
1,1,2-Trichloroethane	0.5	U	Dibromomethane	0.5	U
Ethylene Dibromide	0.5	U			
1,2-dibromo-3-chloropropane	0.5	U			

List 3	MDL	Results ug/L		MDL	Results ug/L
1,2,4-Trimethylbenzene	0.5	U	p-Isopropyltoluene	0.5	U
1,2,3-Trichlorobenzene	0.5	U	Isopropylbenzene	0.5	U
n-Propylbenzene	0.5	U	Tert-butylbenzene	0.5	U
n-Butylbenzene	0.5	U	Sec-bytylbenzene	0.5	U
Napthalene	0.5	U	Fluorotrichloromethane	0.5	U
Hexachlorobutadiene	0.5	U	Dichlorodifluoromethane	0.5	U
1,3,5-Trimethylbenzene	0.5	U	Bromochloromethane	0.5	U

U- Analyzed for but not detected

Analysis Certified By: R
Date: 3/4